

## IN SITU EXHAUST CLOUD MEASUREMENTS

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Airborne in situ exhaust cloud measurements were conducted after the full-scale monitoring activities in late 1974 and early 1975 to obtain better definitions of cloud particle size range,  $\text{Cl}_2$  content, and  $\text{HCl}$  partitioning. Particle size distribution data (from 0.05 to 25 micrometers) and  $\text{Cl}_2$  measurements were made during the May, August, and September 1977 Titan launches.  $\text{HCl}$  partitioning data will be obtained during the March 1978 launch or else in October 1978, the last Titan flight before the Space Shuttle is launched.<sup>1</sup> Basic effluent measurements of Shuttle launches for the scale factor are expected to be obtained in 1978.

Figure 1 plots the measurements of three basic effluents -  $\text{HCl}$ ,  $\text{NO}_x$ , and particles - against minutes after launch. The bounds of measurements for earlier launches (1974 and 1975) are represented by the solid lines, and all the symbols representing followup measurements at these launches in 1977 are superimposed on those bounds. The measurements made in the followup launches in 1977 indicated that the  $\text{HCl}$ ,  $\text{NO}_x$ , and particle concentrations did not exceed the earlier measurements.

The  $\text{Cl}_2$  was measured at the August 1977 and September 1977 launches. Table I compares the maximum observed  $\text{HCl}$  concentration to the maximum  $\text{Cl}_2$  concentration during the first six passes and gives the ratios of the  $\text{Cl}_2$  to the  $\text{HCl}$ . The in situ  $\text{Cl}_2$  measurements from the Voyager launch monitoring activities show that the maximum observed concentrations were approximately 50 parts per billion and well below 1 percent of the observed  $\text{HCl}$  concentrations.

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<sup>1</sup>Since the Environmental Effects Project Review was held, the data from the March 1978 launch have been obtained; they will be the subject of a separate document.

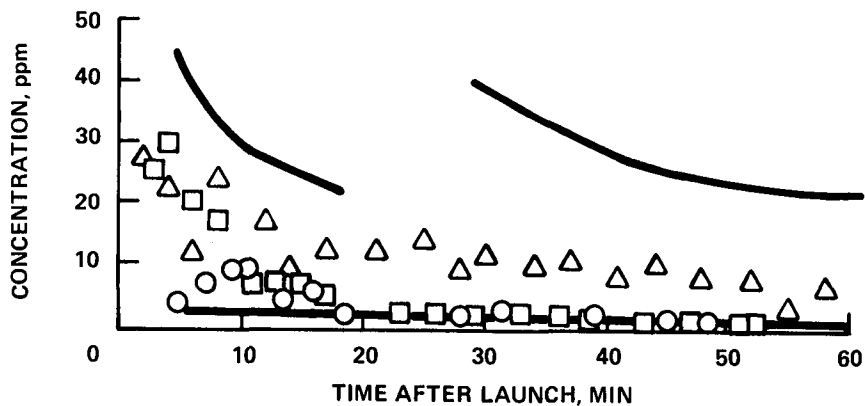
TABLE I.- COMPARISON OF MAXIMUM OBSERVED HCl  
CONCENTRATION WITH MAXIMUM Cl<sub>2</sub> CONCENTRATION

Pass number	Maximum concentration		Ratio max. Cl <sub>2</sub> to max. HCl	
	HCl, ppm	Cl <sub>2</sub> , ppb		
August 20, 1977, Titan launch				
1	26	(a)	(b)	
2	30	42	1.4×10 <sup>-3</sup>	
3	23	70 (50) <sup>c</sup>	3×10 <sup>-3</sup>	(2×10 <sup>-3</sup> ) <sup>c</sup>
4	18	82 (55)	4.5×10 <sup>-3</sup>	(3×10 <sup>-3</sup> )
5	7	60 (20)	8.5×10 <sup>-3</sup>	(3×10 <sup>-3</sup> )
6	7	66 (35)	9.4×10 <sup>-3</sup>	(5×10 <sup>-3</sup> )
September 5, 1977, Titan launch				
1	27	40	1.5×10 <sup>-3</sup>	
2	23	30	1.3×10 <sup>-3</sup>	
3	12	<10	<8×10 <sup>-4</sup>	
4	24	22	9×10 <sup>-4</sup>	
5	16	<10	<6×10 <sup>-4</sup>	
6	9.4	<10	<1.1×10 <sup>-3</sup>	

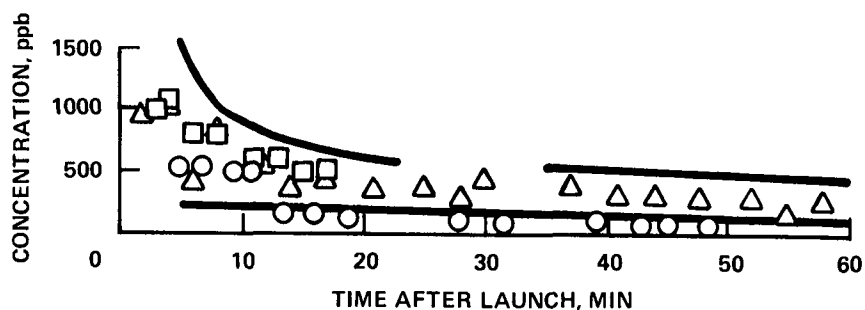
<sup>a</sup>Not measured.

<sup>b</sup>Not applicable.

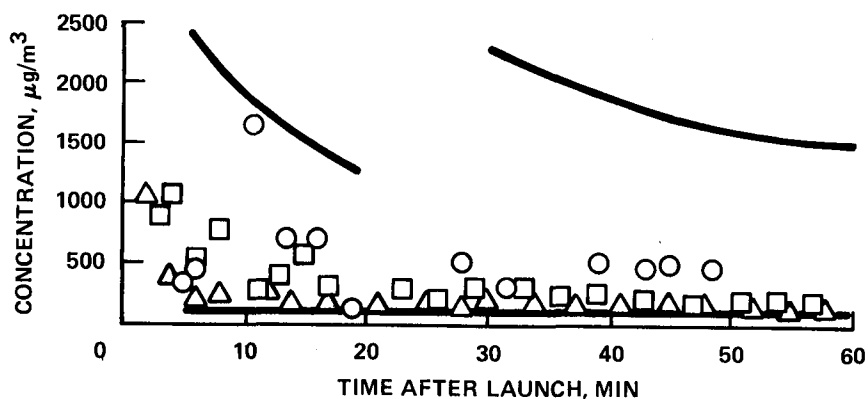
<sup>c</sup>Values in parentheses are in situ measurements of Voyager launches.



(a) HCl.



(b) NO<sub>x</sub>.



(c) Particles.

Figure 1.- Measurements of three basic effluents.